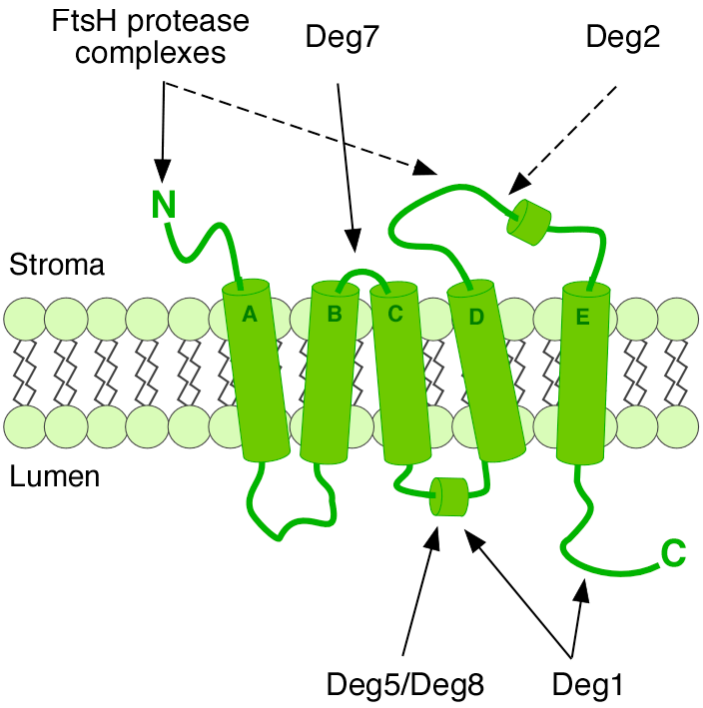
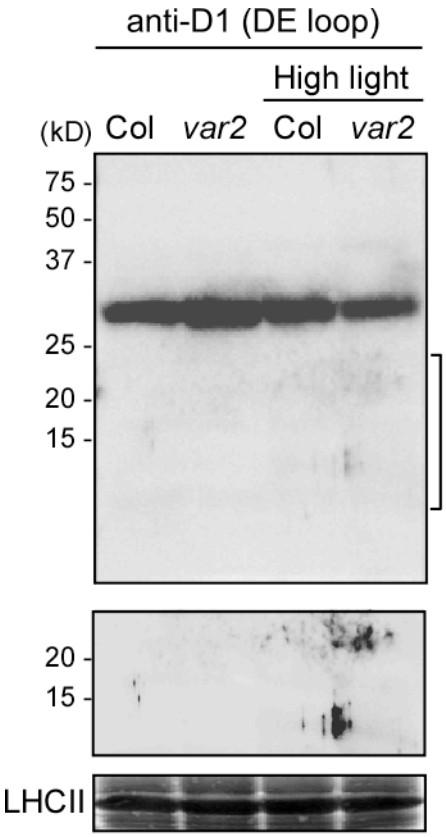
Supplemental Table S1 The ratio of variable to maximum quantum yield of PSII (Fv/Fm) measured from mature leaves using the FluorCam 700MF.

Plant	Maximum quantum yield of PSII (Fv/Fm) *	
	High-light (2,500 μmol photons m^{-2} s^{-1})	
	0 min	60 min
Col	0.812 ± 0.008	0.414 ± 0.043
var2	0.818 ± 0.011	0.266 ± 0.071

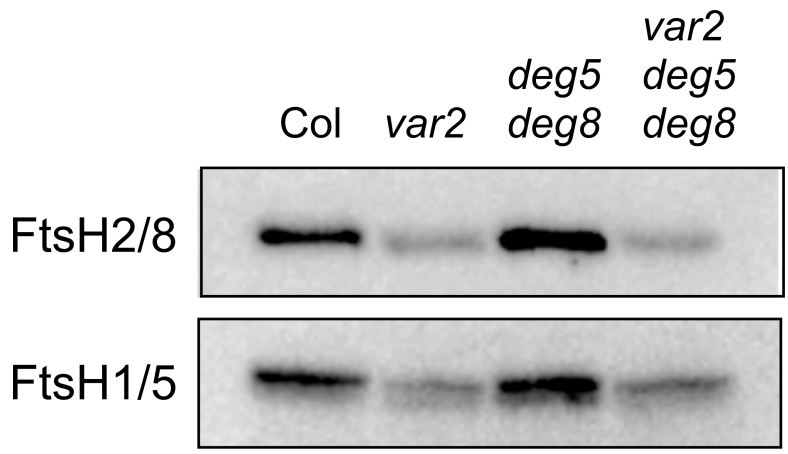
* At each time point, leaves were dark adapted for 10 min prior to measurement. Values are means ± sd (n = 5).



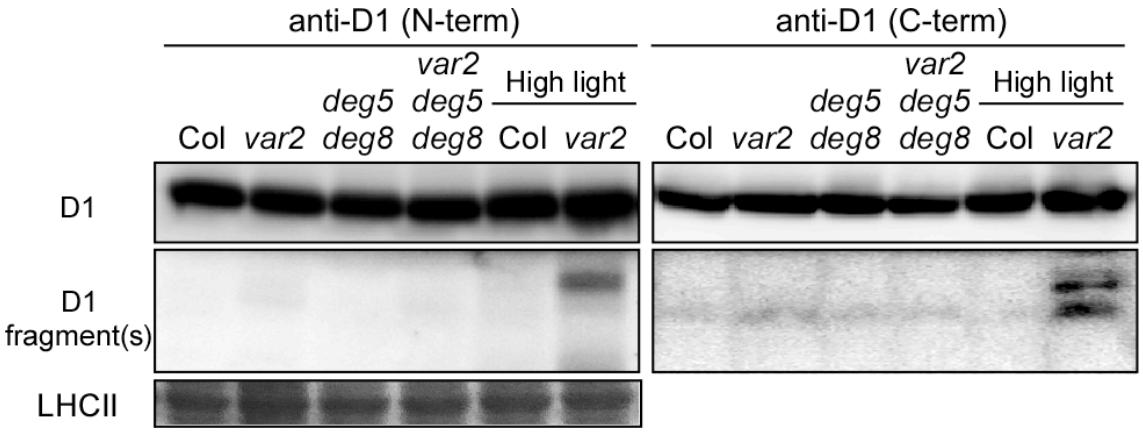
Supplemental Figure S1 Schematic summary of the degradation of D1 protein till this study. FtsH and Deg proteases that have been reported in Arabidopsis are shown and the arrows indicate degradation/cleavage points. The solid and dashed line mean the in vivo evidence and the in vitro experiments, respectively.



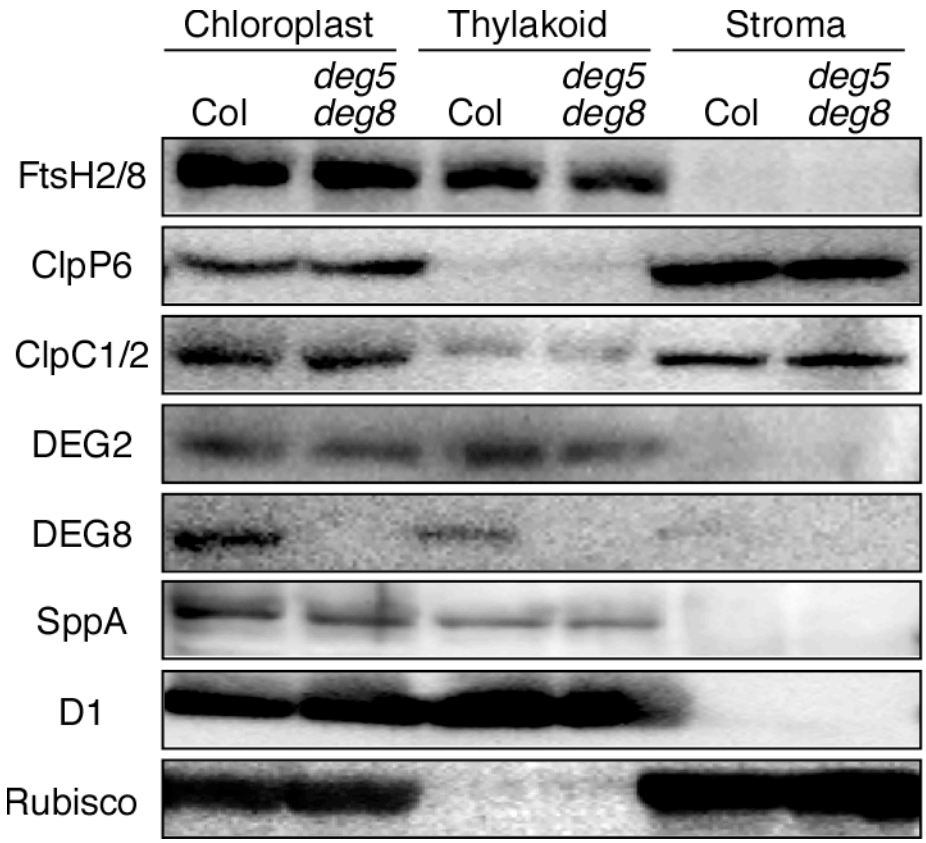
Supplemental Figure S2 Immunoblot analysis of the cleavage product of the D1 protein by anti-D1 (DE loop) antibodies under normal- and high-light conditions. Mature leaves of Col and *var2* (approximately 6-weeks-old plants grown under normal conditions) were illuminated at normal-light (180 μmol photons m^{-2} s^{-1}) and hight-light (2,500 μmol photons m^{-2} s^{-1}) for 1 h. A representative immunoblot using anti-D1 (DE loop) antibodies and the band corresponding to CBB-stained LHCII are depicted. A selective detection of the area indicated by a side bar is shown at the middle panels.



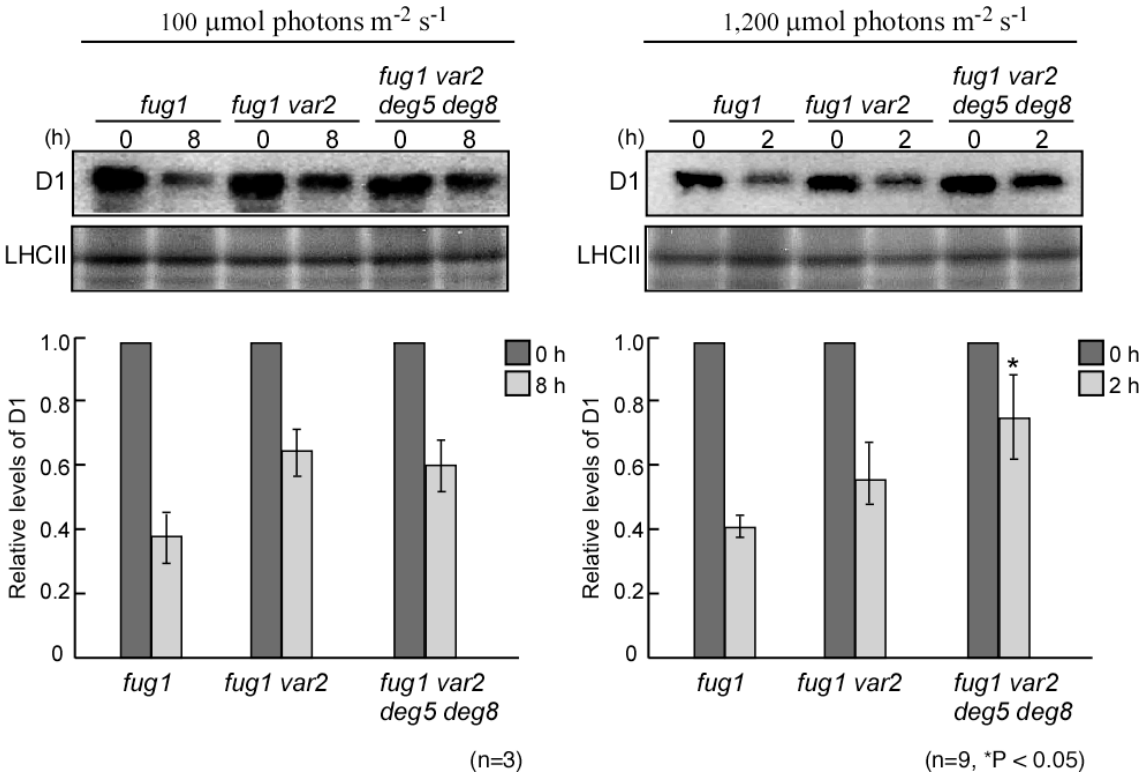
Supplemental Figure S3 Level of FtsH isomers in the mutants. Membrane proteins were separated using SDS-PAGE and probed against typeA (FtsH1/5) and typeB (FtsH2/8) FtsH isomers. Samples were equally loaded based on chlorophyll contents.



Supplemental Figure S4. Immunoblot analysis of the cleavage products of the D1 protein in *var2 deg5 deg8* mutant under normal light condition. Detached leaves of Col, *var2*, *deg5 deg8*, and *var2 deg5 deg8* (approximately 6-weeks-old plants grown under normal conditions) were incubated under nonphotoinhibitory light condition (180 μmol photons m^{-2} s^{-1}) for 1 h. The samples of Col and *var2* leaves that were incubated at high-light (2,500 μmol photons m^{-2} s^{-1}, for 1 h) were loaded as controls. A representative immunoblot using anti-D1 (N-term) and anti-D1 (C-term) antibodies and the band corresponding to CBB-stained LHCII are depicted. A selective detection of the cleavage products of the D1 protein is shown at the lower panels.



Supplemental Figure S5. Steady state accumulation and localization of chloroplast proteases. Chloroplasts were purified by a Percoll step gradient from mature leaves of Col and *deg5 deg8*. Intact chloroplasts were fractionated into stroma and membrane fractions. Proteins were separated by SDS-PAGE and blotted against specific antibodies. D1 and Rubisco large subunit were used as markers of membranes and stroma, respectively.



Supplemental Figure S6. Immunoblot analysis of D1 protein in *fug1, fug1 var2* and *fug1 var2 deg5 deg8* mutants. In vivo measurement of D1 turnover in variegated leaves gives limited results. To minimize such an experimental problem, a suppressor mutant of leaf variegation is used. The FU-GAERI1 (FUG1) locus encodes a chloroplastic translation initiation factor 2 (cpIF2). A leaky mutation in *fug1* recovers leaf variegation when combined with *var2* and *var2 deg5 deg8*. To isolate the quadruple mutant *fug1 var2 deg5 deg8*, *var2* was crossed with *fug1 var2* and *var2 deg5 deg8*. D1 turnover in the absence of FtsHs was assessed in *var2 fug1* and in the absence of FtsHs and Deg proteases was assessed in *var2 fug1 deg5 deg8*, and we used *fug1* as a control. Mature leaves of *fug1, fug1 var2* and *fug1 var2 deg5 deg8* (approximately 6-weeks-old plants grown under normal conditions) were preincubated with 5 mM lincomycin. The leaves were incubated for 2 h under high light condition (1,200 μmol photons m^{-2} s^{-1}) or for 8 h under growth light condition (100 μmol photons m^{-2} s^{-1}). A representative immunoblot using anti-D1 (C-term) antibodies and the band corresponding to CBB-stained LHCII are depicted. Signals of immunoblots from nine biological repeats were quantified using the ImageJ program and normalized to the amount of CBB-stained LHCII (SD with bars). Asterisk indicates statistically significant difference with the D1 degradation ratio in *fug1 var2* ($P < 0.05$). To compare D1 levels, ratios at 0 h were adjusted to 1.